CHAPTER 8

Cutting Fluids and Lubricants

INTRODUCTION

Numerous machining operations such as turning, drilling, milling, shaping, planing, honing, drawing and blanking are performed on a machine in a workshop. During these machining processes, a lot of heat energy is generated which is either wasted unnecessarily or proves harmful to the tool or work or both. To overcome and minimise these adverse effects and to increase the tool life as well as to improve the surface finish on the job, the cutting fluid is used. Similarly, when two or more metal surfaces are in contact with each other and they either slide or run with respect to one another, a lot of wear takes place. This spoils the mating surfaces and, due to an increasing frictional resistance, prevents their smooth running or sliding. These adverse effects are also minimised to a considerable extent by using the cutting fluid which forms a sort of film between the mating surfaces, preventing them from coming into direct contact with each other.

N.B. : Any substance applied to a cutting tool during cutting operation to facilitate the removal of chips and increase tool life is known as coolant or lubricant or cutting fluid.

8.1. FUNCTIONS OF CUTTING FLUID

The functions which a cutting fluid performs during cutting operations are given below ;

1. It minimises the friction between the mating surfaces and prevents rise in temperature.
2. It increases the tool life and produces better surface finish by carrying away the heat generated during metal cutting.
3. It provides a cushioning effect between the tool and job surface to prevent adhesion of the two as in stamping and extrusion processes.
4. It washes away the chips, scale and dust from and in between the mating surfaces.
5. It protects the finish surface from corrosion.
6. It reduces the cutting forces.
7. It provides lubrication effect to the tool, workpiece and chip.
8. It keeps the tool and workpiece cool by dissipating the heat generated during different machining operations.

8.1.1. Essential Properties of a Cutting Fluid

A good cutting fluid should have the following essential properties :

1. It should have low viscosity to permit free flow from storage tank to workpiece and to drip from chips.
2. It should be chemically stable.
3. It should have high flash point so that it is not liable to spontaneous combustion to eliminate fire hazard.
4. It should not cause skin irritation.
5. It should prevent the electrochemical effects of corrosion.
6. It should have a low evaporation rate and should not fume.
7. It should not deteriorate in storage.
8. It should suit to various cutting tools.
9. It should not cause discolouration to the work, machine or tool.
10. It should be non-corrosive.
11. It should have anti-welding properties towards the tool and workpiece.
12. It should not have any adverse effect on the operator, tool, workpiece or machine.
13. It should be cheap and economical.
14. It should be readily available.
15. It should have fair transparency so that the cutting action of the tool may be observed.
16. It should not have objectionable odour for the operator and the persons working around.
17. It should not smoke or fog when in use.
18. It should have sufficient heat carrying capacity to cool the workpiece and tool.
19. It should have good lubricating quality.
20. It should be non-poisonous.

8.2. TYPES OF CUTTING FLUIDS

The following are the main types of cutting fluids :

1. Neat cutting oils
2. Soluble oils
3. Straight oils or Mineral cutting oils
4. Chemical additive oils
5. Sulphurised mineral oils
6. Chemical compounds
7. Synthetic fluids
8. Semi-synthetic fluids.

8.2.1. Neat Cutting Oils

As the name indicates, these oils are not mixed with water for the cutting operation. Actually, these oils are it is a blend of a number of different types of mineral oils, together with additives for extreme pressure applications. The neat cutting oils are used for severe cutting conditions when slow speeds and feeds are used. The main advantage of these oils are their excellent lubricating property and good rust control.

8.2.2. Soluble Oils

These are compounds of mineral oil and an emulsifying base. When mixed with water then emulsifying base causes the formation of oil-water emulsion.

Water has excellent cooling properties and the oil provides lubrication and corrosion resistance. The amount of water varies according to the type of operation. For light cutting operation as in grinding, it requires only a small percentage of oil, as low as 100 : 1. For the superior cooling, lubrication and corrosion resistant properties of such cutting fluids make them a general choice for drilling, milling and lathe work.

8.2.3. Straight Oils or Mineral Cutting Oils

These are composed of one or more of mineral oils, fatty oils or fatty acids. Mineral cutting oils are used in light machining operations. The fatty oils, both animals and vegetables are used in combination with minerals oils. Fatty oils are not chemically active so they do not stain the ferrous or non-ferrous materials.

8.2.4. Chemical Additive Oils

Sulphur and chlorine as additives increase the lubricating and cooling qualities of cutting oils. They also provide anti-weld properties to the cutting oils.

8.2.5. Sulphurised Mineral Oil

They are commonly used for machining the tough, stringy, low carbon steels. These oils minimise tearing and rough finishes caused by built up edges. Highly sulphurised mineral oils are not suitable for copper and its alloys as these oils form stains on these materials.

8.2.6. Chemical Compounds

These are mainly rust inhibitors, such as sodium nitrate mixed with a high percentage of water being favoured as coolants especially in grinding operations. The water acts as a good coolant. Where lubricating properties are not important and only guard against rust on machine and parts produced is desirable, the use is made of such cutting fluids.

8.2.7. Synthetic Fluids

These fluids contain no oil but a mixture of chemicals dissolved in water to give lubricating and anti-corrosion properties. Synthetic fluids form a clear transparent solution with water and are used in grinding operations after dilution upto 1 in 80.

They are easily mixed with water and do not smoke during cutting. Synthetic fluids give excellent rust control. A dilution between 1 in 20 and 1 in 30 is used for general machining.

8.2.8. Semi-synthetic Fluids

These are the recently developed cutting fluids, referred as chemical emulsions. These fluids have small amount of oil emulsified in water and dissolved chemicals. When mixed with water, they form extremely stable transparent fluids with the oil in very small droplets. The advantage of semi-synthetic fluids is increase control of rust and rancidity and a greater application range. These fluids are safer to use as they do not smoke and leave no slippery film on work, machine or floor. Depending on the application, the dilution varies between 1 in 20 and 1 in 100.

8.3. DIFFERENCE BETWEEN CUTTING FLUID AND LUBRICANT

The following table gives the difference between cutting fluid and lubricant :

S.No.	Cutting fluid	Lubricant
1.	It is used to reduce the heat produced by the tool and work.	It is a substance having the property of stickiness. Oil and oily substances are called lubricant. The method of applying the lubricant is called lubrication. It reduces friction between the operating parts.
2.	It contains soluble oil with water.	It does not contain any soluble oil and water.
3.	It is the life blood to the tool and workpiece *i.e.* increases the life of the tool and helps in improving the surface finish.	It is the life blood to the machines used to keep up the vital parts in perfect condition and to prolong the life of the machine.
4.	It cools the job and helps to avoid expansion by heat.	It prevents the metal to metal contact, thus minimising wear and tear.
5.	Flash point of cutting fluid is less than the lubricant.	Flash point of lubricant is more than the cutting fluid.
6.	Oxidation can occur due to the presence of water.	Oxidation does not occur in case of lubricant.
7.	It helps to wash away the cutting chips and to control the flying chips.	It prevents the entry of extraneous and abrasive material into the bearing. It also serves as a protective film.

8.4. SELECTION OF CUTTING FLUIDS FOR DIFFERENT MATERIALS AND OPERATIONS

8.4.1. Selection of Cutting Fluids

The selection of a particular cutting fluid for a particular operation depends upon many factors. The main deciding factor is the service expected of the fluid. When the fluid is used only for cooling purpose, the emulsions are the best. But when the anti-welding and lubricating properties are the primary requirements, the straight mineral oils are necessary. If, however the performance of both the emulsions and the straight mineral oils is similar, the cost of the cutting fluid is the deciding factor. Further in the selection of cutting fluids, it is necessary to take into consideration the cutting speed, depth of cut as well as the nature of the material being cut. A few such considerations regarding selection of cutting fluids are as given below ;

8.4.1.1. Low speeds and shallow cuts

It requires little cooling or lubrication. Hence, use of straight mineral oils may be used as cutting fluids.

N.B. : In case of non-availability of cutting fluid, the metal may be machined dry.

8.4.1.2. Low speeds and heavy cuts

Especially in this case when tough material is being cut, it requires a lubricant of considerable oiliness *i.e.* fatty mineral oil.

8.4.1.3. Shallow cuts at high speeds

It requires good coolants. Therefore, emulsions of soluble and sulphur based cutting oils are employed.

N.B. : When lubricating properties are not important, aqueous solutions with chemical compounds serve the purpose.

8.4.1.4. Heavy cuts at high speeds

It requires a cutting fluid that acts as a coolant as well as a lubricant *i.e.* sulphurised fatty mineral oils.

8.4.1.5. Brittle materials

These are often cut without the use of a lubricant as cast iron although emulsions of soluble oil in water may be employed.

8.4.1.6. Tough materials

These are machined using highly compounded oils.

8.4.1.7. For light cuts and good surface finish

Sulphur based oils or emulsions of soluble oil may be used for light cuts and good surface finish.

8.4.1.8. Soft metals

These may be machined dry or with light viscosity oils *i.e.* turpentine for aluminium and aluminium alloys.

8.4.1.9. For anti-weld property

Use is made of chlorinated oils or sulphurised oils during machining.

8.4.1.10. Discolouration

Aluminium, aluminium alloys, copper, brass and bronze get discolouration by using sulphurised oils while machining. Hence, such oils should not be used with these materials.

N.B. : Fatty oils do not stain either the ferrous or the non-ferrous materials.

8.4.2. Cutting Fluids for Various Materials

The following table gives the commonly used cutting fluids for some of the materials :

S.No.	Material	Cutting fluid
1.	Low carbon steel	Soluble oil or Sulphurised mineral oil
2.	High carbon steel	Sulphurised fatty oil
3.	Cast iron	Usually, machined dry
4.	Wrought iron	Sulphurised fatty oil
5.	Stainless steel	Sulphurised fatty oil
6.	Monel	Sulphurised fatty oil
7.	Nickel	Sulphurised fatty oil
8.	Copper and copper alloys	Mineral oil or Soluble oil
9.	Cast brass	Usually, machined dry
10.	Aluminium and aluminium alloys	Dry or Light viscosity oil, *e.g.*, turpentine
11.	Magnesium	Dry or Light viscosity inactive oils

8.4.3. Use of Cutting Fluids in Different Machining Operations

The following table gives the common application of various cutting fluids in different machining operations. The selection of a suitable composition depends upon the cutting conditions.

S.No.	Operation	Cutting conditions and other requirements	Suggested fluids
1.	Turning	Selection of cutting oil depends upon the cutting speed, feed and material being turned.	Emulsions or Straight oils.
2.	Sawing	Cutting fluid is required for cleaning the saw teeth, carry away the heat generated and prevent adhesion of chips.	Soluble oil.
3.	Tapping and threading	Main requirement is lubrication as the cutting speeds are low.	Active type mineral fatty oil. Of course, occasionally, emulsions of soluble oils are used.
4.	Drilling and boring	The requirements are of lubrication and cooling both, so as to avoid chatter, minimise heat generation and cool the tool and work.	Soluble oils.
5.	Reaming	Main requirement is lubrication.	Soluble oils.
6.	Automatic machining on single and multiple spindle automatic lathes, turret and capstan	Higher speeds are involved and a large number of different types of operations are performed.	A high viscosity active cutting oil with some fatty oil.
7.	Broaching	Heavier cuts are taken.	Heavy, active type cutting oils ; particularly in horizontal internal broaching.
8.	Planing and shaping	—	Usually, no cutting oil is used.
9.	Milling	The common requirements include cooling, lubrication and prevention of tool chatter.	Sulphurised mineral fatty oils or emulsions in ample quantity.
10.	Thread rolling	—	Straight mineral oil or emulsions.
11.	Gear cutting, shaping and shaving	—	Active type mineral oils and compounds.
12.	Grinding, lapping and honing	1. Lubrication being the main consideration, such as in thread grinding, form grinding and honing. 2. Where cooling is the main requirement, such as in cylindrical, centreless and surface grinding.	1. Active type mineral oils and compounds. 2. Emulsions of soluble oils or paste type.
13.	Machining plastic materials	The main requirement is of cooling particularly in operations like drilling tapping and threading.	1. Brittle materials can be machined dry or with an air blast. 2. If a fluid is required, a dilute emulsion of soluble oil should be used in ample quantity.

8.4.4. Commercial Cutting Fluid

The commercial cutting fluids are sold in the market under different trade names and it is advisable that the advice given by the manufacturers with regard to the use of these fluids should be followed carefully.

The following table gives the brand names, description and main applications of the cutting fluids and drawing compounds manufactured and marketed by Bharat Petroleum Corporation Ltd. (India).

S.No.	Brands	Description	Recommended main applications
1.	Bharat Sherol B	It is a soluble oil possessing anti-corrosion properties. It is supplied neat, but before use it is added to water (1 part of oil to 20 – 30 parts of water) and forms an opaque milky white stable emulsion. Oil must be added to water, not water to the oil.	It is used for general machinery operations on easily worked materials, where cooling is more important than lubrication. It is also suitable as an anti-corrosion agent in certain cooling and hydraulic systems using water.
2.	Bharat Sherol E	It is a water-base fluid having enhanced load carrying capacity. It forms a very clear emulsion.	It is recommended for use in severe grinding operations.
3.	Bharat Triponol cutting oils (Grades A, B, C, D and H)	These are transparent, active, extreme-pressure cutting oils.	These are recommended for use in severe cutting operations on materials difficult to machine, *e.g.* tough steels. These are not recommended for use on non-ferrous metals which they are liable to stain.
4.	Bharat Noream oils (Grades A, B, C and 27)	These are transparent inactive, extreme-pressure cutting oils.	These are specially suitable for operations on non-ferrous metals, but may also be used on ferrous metals under less severe machining conditions.
5.	Bharat cutting compound	It is a soluble oil.	It is used for milder machinery operations. It forms a stable milky white emulsion when 1 part of oil is added to 20 to 25 parts of water.

S.No.	Brands	Description	Recommended main applications
6.	Bharat High Speed cutting compound	It is a neat cutting oil.	It is used for more severe machining operations.
7.	Bharat Drawing compound F	It is an emulsifiable paste.	It is used in deep drawing pressing, wire drawing and bar drawing operations as a metal working lubricant.
8.	Bharat Drawing compound H	It is an emulsifiable paste containing a filler.	It is used as a metal working compound used for heavy deep drawing, tube drawing and bar drawing.

8.4.5. Handling of Cutting Fluids

Some hints and precautions regarding handling of cutting fluids are given below :

1. To avoid contamination of the cutting fluid the cleanliness of machine and operator is imperative.
2. Frequently disinfectant, such as crude carbolic acid 1 part in 500 of liquid or *p*-cresol 1 part in 1000 etc. is added to the cutting fluid.
3. The liquid may also be sterilized at intervals by heating it to the pasteurising temperature of 60 °C for not less than 20 minutes.
4. The low cost emulsions may be changed frequently whereas the more expensive oil should be treated carefully. The oils from the self contained units are removed from the machine, to be filtered and sterilized before being used again.
5. In large production shops a continuous system for circulating, purifying and filtering the cutting fluid is provided so that the liquid may be delivered through pipes to a whole battery of machines.
6. In large production, the chips from the machines are placed in a centrifugal extractor to reclaim the oil which is then treated and again put in service.
7. Large settling tanks should be provided so that the sediments in the cutting oil may settle out before being recirculated.
8. The liquid is filtered as it flows by gravity from the cutter back to the storage tank, so as to remove small chips and foreign matter.

8.5. COMMON METHODS OF LUBRICATION OF MACHINE TOOLS

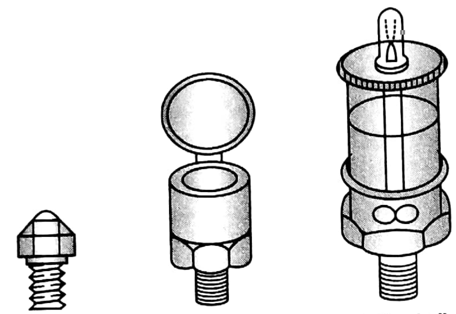
There are various methods to supply lubricant to machine tools according to the working system of parts and machine. The most commonly used methods of lubrication of machine tools are given below ;

1. Gravity feed method
2. Grease cup method

3. Grease gun method
4. Hand oiling method
5. Oil can method
6. Force feed method
7. Splash lubrication method.

8.5.1. Gravity Feed Method

In gravity feed method, the lubricant is applied to the sliding parts through oil nipples or oil cups located at the top of the moving parts. The various designs of nipples and cups are shown in Fig. 8.1 (*a*), (*b*) and (*c*). The cup is filled with oil which flows to the moving part under gravity. Sight feed oil cup or a glass lubricator is fixed on the machine part. It has a small hole for inserting a wick. The oil passes through the wick to the required part drop by drop under gravity.

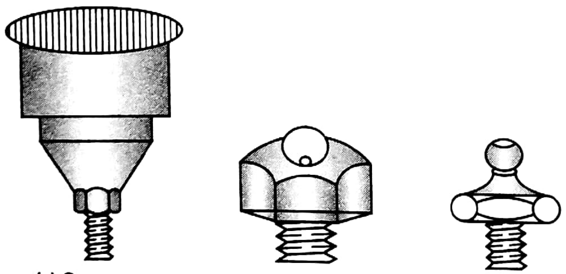


(*a*) Oil nipple. (*b*) Oil cup. (*c*) Sight feed oil cup.

Fig. 8.1. Gravity feed oil cup.

8.5.2. Grease Cup Method

Parts operating at high speeds and at high temperatures require high quality greases. The grease cups as shown in Fig. 8.2 (*a*), (*b*) and (*c*) are screwed at the appropriate place on the machine part. These cups are filled with suitable grease for lubricating the parts by self system.

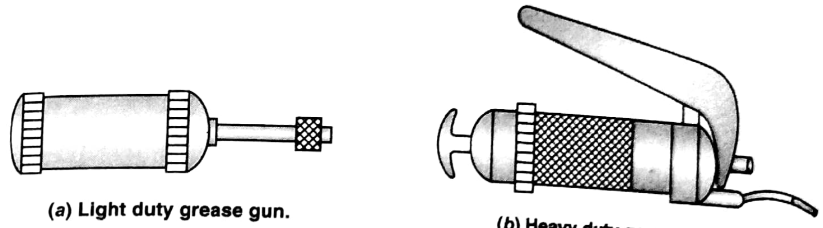


(*a*) Grease cup. (*b*) Nipple. (*c*) Nipple.

Fig. 8.2. Grease lubricators.

8.5.3. Grease Gun Method

The commonly used grease guns are shown in Fig. 8.3 (*a*) and (*b*). The grease gun is used to supply grease to the moving parts under pressure which can not be greased or oiled through holes. The grease passes to the parts while pumping.



(*a*) Light duty grease gun. (*b*) Heavy duty grease gun.

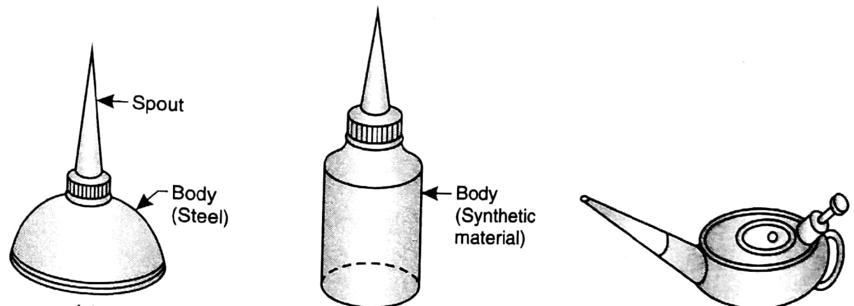
Fig. 8.3.

8.5.4. Hand Oiling Method

Manual application of oil at periodic intervals of time is called the hand oiling. This method of lubrication is inefficient and is rarely used.

8.5.5. Oil Can Method

The different types of oil cans are shown in Fig. 8.4 (*a*), (*b*) and (*c*). It has two main parts, the body and the spout or nozzle. The material used for oil cans is either steel or synthetic. The spout is screwed to the mouth of the body. The oil is filled in the can through the mouth and the supply is made through the nozzle of the can to the required parts either in the inclined position or with the pressure plunger.

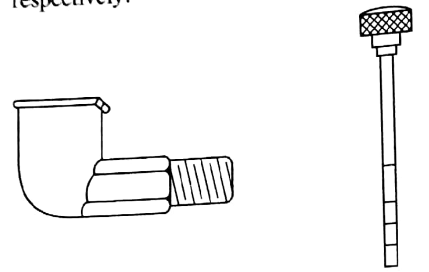


(*a*) (*b*) (*c*)

Fig. 8.4. Different types of oil cans.

8.5.6. Force Feed Method

The force feed method of supplying lubricant to the moving parts is used where gravity method is not applicable. Thus, in force feed system pump is used to supply lubricant to the required parts by pumping and the lubricant so formed is called force feed. Checking of lubricant level in the storage tank is done either with the oil level cup or oil gauge or dip stick as shown in Fig. 8.5 (*a*) and (*b*) respectively.



(*a*) Oil level cup. (*b*) Oil gauge or Dip stick.

Fig. 8.5. Checking oil level.

8.5.7. Splash Lubrication Method

In splash lubrication method, a ring hangs over the shaft around the bearing and the lower part of the ring sinks into the oil reservoir of the housing. The ring revolves when the shaft is in motion and the oil is splashed to lubricate the parts. This method is commonly used in gear driven drills, lathe and milling machines. The oil level in such machine tools is maintained through oil level cups or sight feed glasses.

8.6. CERTIFYING ORGANIZATIONS FOR RATING STANDARDS OF LUBRICANTS

SAE : SAE stands for "Society of Automotive Engineers", a United States organization founded in 1905 by Henry Ford and Andrew Ricker. At present, it is known as SAE International. This group comprises of engineers from automotive engineering, petroleum, trucking and aerospace industries. SAE International issues the viscosity grading system for motor oil, standards for SAE tools etc. It developed a numerical classification system to define the viscosity or thickness of oil. Thus, SAE number is a code to grade motor oils by their viscosity characteristics. The numbers for crankcase lubricants range from 5 to 50, for transmission and axle lubricants, they range from 75 to 250. The lower the number, the more readily the oil flows. The suffix W indicates that the oil is suitable for winter use. W oils are rated according to their flow rates at 0° F, whereas other types are tested at 210° F. Multi grade oils contain additives that oppose the tendency to thicken at low temperature, thereby making the same oil to satisfy the requirements both summer and winter.

ASTM : ASTM stands for "American Society for Testing and Materials". At present, it is known as ASTM International. Basically, it creates the material specifications and standard test methods to determine compliance. Almost all commercial oils contain chemical additives to enhance their performance for a particular application. The ASTM D6443 and ASTM D4927 international standard test methods are used to determine if the oils, additives and additive packages meet specification. These methods employ wavelength dispersive X-ray spectroscopy (WD XRF) and mathematical matrix corrections procedures. XRF is an excellent method for multi-elemental analysis as it provides cost-effective, precise and accurate data and fast data

acquisition. Especially for liquids, the sample preparation is simple and the analysis does not require highly skilled lab personnel.

Important and Expected Questions

Q.1. Define cutting fluid.

Ans. Any substance applied to a cutting tool during cutting operation to facilitate the removal of chips and increase tool life is known as coolant or lubricant or cutting fluid.

Q.2. Write a short note on synthetic fluids.

Ans. Synthetic fluids contain no oil but a mixture of chemicals dissolved in water to give lubricating and anti-corrosion properties. Synthetic fluids form a clear transparent solution with water and are used in grinding operations after dilution upto 1 in 80.

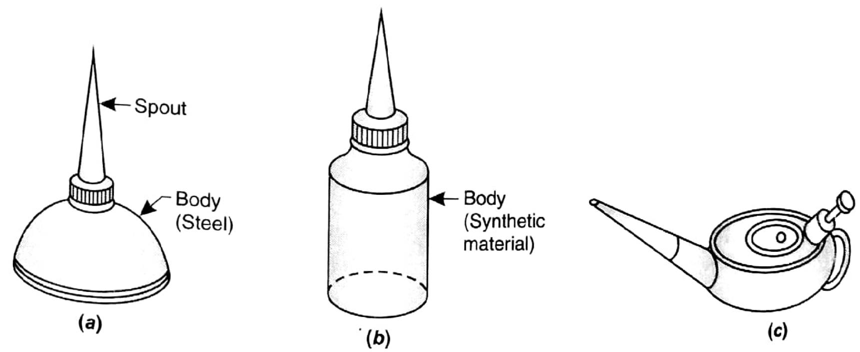
They are easily mixed with water and do not smoke during cutting. Synthetic fluids give excellent rust control. A dilution between 1 in 20 and 1 in 30 is used for general machining.

Q.3. Write a short note on neat cutting oils.

Ans. Neat cutting oils are not mixed with water for the cutting operation. Actually, these oils are it is a blend of a number of different types of mineral oils, together with additives for extreme pressure applications. The neat cutting oils are used for severe cutting conditions when slow speeds and feeds are used. The main advantage of these oils are their excellent lubricating property and good rust control.

Q.4. Write a short note on oil can method of lubricating machine tools.

Ans. The different types of oil cans are shown in figure (*a*), (*b*) and (*c*). It has two main parts, the body and the spout or nozzle. The material used for oil cans is either steel or synthetic. The spout is screwed to the mouth of the body. The oil is filled in the can through the mouth and the supply is made through the nozzle of the can to the required parts either in the inclined position or with the pressure plunger.



Different types of oil cans.

Q.5. Write the main functions of cutting fluid.

Ans. The functions which a cutting fluid performs during cutting operations are given below ;

(*i*) It minimises the friction between the mating surfaces and prevents rise in temperature.

(*ii*) It increases the tool life and produces better surface finish by carrying away the heat generated during metal cutting.

(iii) It provides a cushioning effect between the tool and job surface to prevent adhesion of the two as in stamping and extrusion processes.

(iv) It washes away the chips, scale and dust from and in between the mating surfaces.

(v) It protects the finish surface from corrosion.

Q.6. Discuss any two types of cutting fluids.

Ans. The two types of cutting fluids are as the following :

(i) Neat cutting oils : As the name indicates, these oils are not mixed with water for the cutting operation. Actually, these oils are a blend of a number of different types of mineral oils, together with additives for extreme pressure applications. The neat cutting oils are used for severe cutting conditions when slow speeds and feeds are used. The main advantage of these oils are their excellent lubricating property and good rust control.

(ii) Soluble oils : These are compounds of mineral oil and an emulsifying base. When mixed with water then emulsifying base causes the formation of oil-water emulsion.

Water has excellent cooling properties and the oil provides lubrication and corrosion resistance. The amount of water varies according to the type of operation. For light cutting operation as in grinding, it requires only a small percentage of oil, as low as 100 : 1. For the superior cooling, lubrication and corrosion resistant properties of such cutting fluids make them a general choice for drilling, milling and lathe work.

Q.7. Differentiate between cutting fluid and lubricant.

Ans. The following table gives the difference between cutting fluid and lubricant :

S.No.	Cutting fluid	Lubricant
1.	It is used to reduce the heat produced by the tool and work.	It is a substance having the property of stickiness. Oil and oily substances are called lubricant. The method of applying the lubricant is called lubrication. It reduces friction between the operating parts.
2.	It contains soluble oil with water.	It does not contain any soluble oil and water.
3.	It is the life blood to the tool and workpiece *i.e.* increases the life of the tool and helps in improving the surface finish.	It is the life blood to the machines used to keep up the vital parts in perfect condition and to prolong the life of the machine.
4.	It cools the job and helps to avoid expansion by heat.	It prevents the metal to metal contact thus minimising wear and tear.
5.	Flash point of cutting fluid is less than the lubricant.	Flash point of lubricant is more than the cutting fluid.

Q.8. Write a short note on selection of cutting fluids.

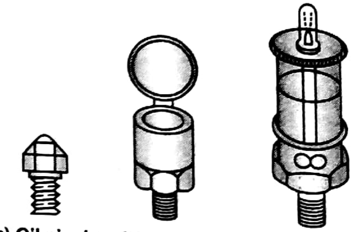
Ans. The selection of a particular cutting fluid for a particular operation depends upon many factors. The main deciding factor is the service expected of the fluid. When the fluid is used only for cooling purpose, the emulsions are the best. But when the anti-welding and lubricating properties are the primary requirements, the straight mineral oils are necessary. If, however the performance of both the emulsions and the straight mineral oils is similar, the cost of the cutting fluid is the deciding factor. Further in the selection of cutting fluids, it is necessary to take into consideration the cutting speed, depth of cut as well as the nature of the material being cut.

Q.9. Enlist the common methods of lubrication of machine tools. Discuss any one of them.

Ans. There are various methods to supply lubricant to machine tools according to the working system of parts and machine. The most commonly used methods of lubrication of machine tools are given below ;

(i) Gravity feed method (ii) Grease cup method (iii) Grease gun method (iv) Hand oiling method (v) Oil can method (vi) Force feed method (vii) Splash lubrication method.

Gravity feed method : In gravity feed method the lubricant is applied to the sliding parts through oil nipples or oil cups located at the top of the moving parts. The various designs of nipples and cups are shown in Fig. (a), (b) and (c). The cup is filled with oil which flows to the moving part under gravity. Sight feed oil cup or a glass lubricator is fixed on the machine part. It has a small hole for inserting a wick. The oil passes through the wick to the required part drop by drop under gravity.



(a) Oil nipple. (b) Oil cup. (c) Sight feed oil cup.
Gravity feed oil cup.

Objective Questions

► Fill in the Blanks ◄

1. Coolants and lubricants .... the tool life.
2. Coolants and lubricants are also called .... fluids.
3. Mineral oils are composed of ....
4. Fatty acid is used as .... in turning work.
5. Emulsion is formed by diluting the .... in water.
6. The .... cutting oils are used in machining copper and copper alloys.
7. A cutting fluid should have .... heat capacity.
8. A cutting fluid should have .... viscosity.
9. The main function of cutting fluid is to .... the heat generated during a machining operation.
10. Splash system of lubrication is very common in .... and .... machines.

► True or False ◄

1. Cutting fluids provide cushioning effect between the job surface and the tool.
2. Metal working fluids reduce the surface finish of the component.
3. Soap and salt solutions in water are generally used as lubricants.
4. The cheapest cooling solution is soda or borax in water.